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Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

Date: September 13, 2013
File Code: 3420

To: District Ranger, American River Ranger District, Tahoe National Forest

Subject: Considerations for fire-injured tree harvest and hazard tree abatement within the 2013 American Fire, Tahoe National Forest (FHP Report NE13-09)

At the request of Kelly Pavlica, Silviculturist, American River Ranger District, Danny Cluck, Forest Health Protection (FHP) Entomologist, visited the American Fire with district staff on September 9 and 10, 2013. The objective of this visit was to evaluate the levels of fire injury to conifers, note any insect activity and discuss variables that should be considered when developing fire-injured tree and hazard tree marking guidelines. Recommendations provided in this report will assist in the formulation of silvicultural prescriptions aimed at removing a portion of the fire-injured trees including the abatement of roadside hazard trees.

Description of the project area

The 27,440 acre American Fire, located ~10 miles northeast of Foresthill, CA, started on August 10, 2013 and was contained August 29, 2013 (T14/15/16, R12/13E). The elevation ranges from 2,500 – 6,800 feet with annual precipitation ranging between 55 and 70 inches. Forest species composition varies with elevation and aspect but most stands are considered Sierra mixed conifer. White fir (*Abies concolor*), Douglas-fir (*Psuedotsuga menziesii*), Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), red fir (*Abies magnifica*), incense cedar (*Calocedrus decurrens*) and black oak (*Quercus kellogii*) all occur within the fire perimeter.

General observations

Observations were made at a number of locations representing different vegetation burn severities and forest species compositions. However, due to the large area encompassed by the fire, some post-fire stand conditions likely exist that were not reviewed during this evaluation.

- Most of the red fir along the Robinson Flat Road sustained low levels of crown scorching

Danny Cluck
Forest Entomologist
530-252-6431
dcluck@fs.fed.us

Bill Woodruff
Plant Pathologist
530-252-6880
wwoodruff@fs.fed.us

but bole scorch and associated cambium kill was low to moderate. Some of the trees that are within striking distance of the road will meet the 1/3 cambium kill criteria, indicating high failure potential, as outlined in the R5 hazard tree guidelines (Angwin et al 2012).

- Old growth sugar pine and ponderosa pine at Ford Point sustained a wide range of fire injuries. Crown scorching in some of the ponderosa pine did not appear to result in crown kill (refer to Smith and Cluck 2011 for detailed discussion of crown scorch versus crown kill for yellow pine). Many sugar pine sustained high levels of crown kill and have a low probability of survival. Cambium kill was mostly low on sampled trees of both species but further inspection is recommended for trees that appear to have had high levels of duff and litter consumed around their base.
- The ponderosa pine plantation (western plantation) under contract for thinning had high levels of crown scorch/kill in small patches that will likely result in tree mortality. However, most trees appeared to have sustained low to moderate levels of crown kill and very little cambium injury (Figure 1).

Figure 1. Light crown scorching of plantation pines scheduled for thinning.

- A small area of white and red fir in the Last Chance project where back burning operations were conducted sustained very high levels of basal cambium kill. This was caused by the consumption of heavy surface fuel loads created during a previous lop and scatter thinning treatment. Many of the green crowned roadside trees in this area will likely be considered hazards upon further inspection (Figure 2).
- Ambrosia beetle activity on boles of individual white and red fir was apparent at several locations indicating patches of severely injured or dead cambium.

Figure 2. Deep white ash around red and white fir as a result of heavy surface fuel consumption.

- Wood-boring beetle larvae were observed in one bole scorched white fir. Due to the timing of the fire (August), it is likely that many fire-killed and severely injured trees are currently infested by wood-boring beetles.

Pre-fire bark beetle activity

FHP aerial detection surveys mapped mortality within and adjacent to the American Fire area in 2011 and 2012 (2013 data not available). Fir engraver beetle (*Scolytus ventralis*)-caused mortality of white fir was elevated in 2011 but not in 2012. In 2012, western pine beetle (*Dendroctonus brevicomis*)-caused mortality of ponderosa pine and mountain pine beetle (*Dendroctonus ponderosae*)-caused mortality of sugar pine were slightly elevated but restricted to single trees or small groups (<5 trees/group).

Post-fire bark and woodboring beetle activity

The amount of post-fire insect activity and the resulting tree mortality depends on many factors such as the timing of the fire, the level of insect activity in the area prior to the fire, stand characteristics and precipitation. For the American Fire, most bark beetle activity in fire-injured trees will begin in the spring of 2014 and continue for 3 to 5 years. Elevated levels of mountain pine beetle and western pine beetle activity should be expected in fire-injured sugar and ponderosa pine due to the elevated level of pre-fire tree mortality caused by these species. The high number of fire-injured trees and the continuing dry conditions may help to increase bark beetle populations dramatically over the short-term. The highest mortality levels are expected in the moderate and high vegetation burn severity areas with scattered mortality in the low vegetation burn severity areas. Bark beetle activity in fire-injured trees is not likely to result in a population buildup that will subsequently spread into adjacent unburned stands at a significant level. When this has been observed, mortality was restricted to individual trees and small stands that were directly adjacent to the fire perimeter and were generally in an unhealthy condition due to overstocking and drought.

The level of fire-injury on an individual tree plays a role in post-fire insect activity. Fire-injured trees can be placed into three categories: 1) those killed outright or injured so severely that they will soon die, 2) those that are lightly injured and should survive, and 3) those in between, the moderately injured trees. Bark beetles will attack trees in all three categories but successful brood production will only occur in trees with moist cambium. Trees in category one typically do not have enough moist cambium after the fire or if they do, it will become either resin soaked or dry out before beetles can complete their development. Bark beetles attack these types of trees at lower rates and also experience extreme competition from wood-boring beetle larvae, reducing reproductive success. Trees in category two provide the highest level of suitable cambium for bark beetles but typically are not injured to the extent that their defenses are compromised. These trees still have the ability to pitch out beetles as they attack, or more often, are avoided by bark beetles altogether. The highest level of bark beetle attacks are likely to occur on trees in category three, the moderately injured trees. These trees will have moderate to high levels of crown scorch and cambium injury that compromise their defense systems, putting them at a higher probability of mortality. These trees provide ideal habitat for bark beetles for several years post-fire, especially if cambium injuries are concentrated on the lower bole or at the root collar.

The current level of wood-boring beetle activity in fire-killed trees will become apparent in late winter 2014 when woodpeckers begin removing bark to feed on larvae. Wood-boring beetles are likely to attack and successfully reproduce in both moderate and severely injured trees as well as trees killed outright by the fire. Trees that had crowns completely consumed (blackened) are typically the first be attacked, some within days of the fire. Wood borers will also attack trees that had crowns completely scorched but not consumed (red needles remaining) but initially at a lower intensity than blackened trees. Tree diameter also plays a role as initial attacks tend to be concentrated on smaller diameter trees and the tops of larger diameter trees and then increase and spread into the lower boles of larger diameter trees. Wood borers are not a threat to healthy trees within or adjacent to the burned areas.

The level of wood borer activity and the amount of deterioration to trees designated for harvest can also vary by tree species and size, timing of fire-injury, and by geographic location. For example,

among the fires of 2012, the Reading Fire (Lassen NF) had extremely high levels of wood borer activity and associated deterioration of harvest trees one year post-fire while the Barry Point Fire (Modoc NF) and the Chips Fire (Lassen/Plumas NF) had significantly less activity and deterioration over the same timeframe. All of these fires burned in late-July through August. The Reading Fire burned in close proximity to the 2009 Sugarloaf fire (11,269 acres), which may be a partial explanation for the high level of wood borer activity observed within the first post-fire year.

Economic Losses and Potential Hazards Caused by Staining and Decay Fungi

Significant degrade and value losses are highly likely if fire-injured trees proposed for harvest are not removed promptly. Nearly all of the beetles previously discussed carry spores of staining and/or decay fungi that immediately begin to invade sapwood (Figure 3). Blue stain, although not a source of structural degrade, can dramatically reduce the economic value of pine species. Blue stain spreads rapidly into the sapwood and by the end of one year can typically be found in nearly all dead and dying pines. An FHP monitoring study (Eglitis 2006) of 84 fire-killed ponderosa pines in central Oregon found blue stain in 100% of the first 16.5 foot bole sections and in 58% of the second 16.5 foot sections of sampled trees one year post-fire. At the end of two years, 92% of sampled trees had blue stain throughout the entire bole. The occurrence of blue stain within the American Fire is not likely to increase significantly until temperatures warm again next spring/summer and additional bark and wood-boring beetle activity carries staining fungi to more trees. Decay fungi that are introduced typically do not cause significant degrade until after the first post-fire year, with smaller diameter trees decaying faster than large diameter trees.

Figure 3. Woodboring beetle galleries (holes in sapwood) and blue stain.

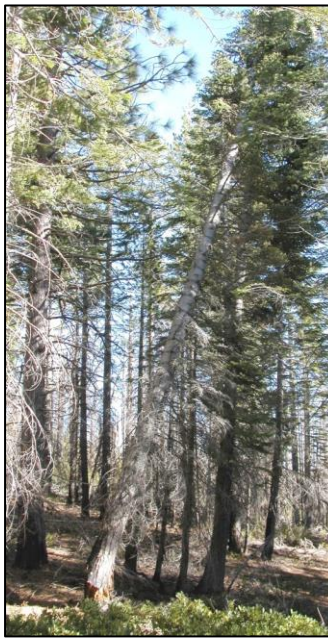
Figure 4. Green fire-injured white fir failure five years post-fire.

Sapwood decay can create significant tree hazards in addition to a reduction in economic value. This is particularly true for fire-injured true fir, as surviving trees that develop extensive sapwood decay over the next few years could present hazards to the road system and crews working in burned stands. Previous FHP monitoring of fire-injured trees revealed the failure of 8" to 24" dbh red and white fir, with green crowns, in as little as three years (Figure 4) (Report: SPR-07-05). The rate of failure increased dramatically after the fourth year, especially in conjunction with high winds or heavy snows. This type of post-fire tree failure was observed in the 1999 Bucks Fire (Plumas NF), 2001 Star Fire (Tahoe NF) and the 2000 Storrie Fire (Lassen NF).

Fire-injured rust resistant sugar pine

FHP monitoring and post-fire observations of fire-injured sugar pine indicate that they are highly attractive to mountain pine beetles and are often attacked when they have sustained moderate to high levels of cambium injury. Due to the elevated levels of mountain pine beetle activity in sugar pine before the fire, the American River RD should consider single tree protection measures that will prevent rust resistant trees from being attacked. Treatment alternatives include the use of anti-aggregation pheromones to repel attacking beetles or spraying insecticides on tree boles to kill beetles as they attempt to attack the tree. FHP is available to assist with either option upon request.

Fire-injured tree marking guidelines

The guidelines developed by Region 5 FHP, *Marking guidelines for fire-injured trees in California* (Smith and Cluck 2011) are appropriate for use in the American Fire. The following factors should be considered when selecting the probability of mortality(s) for tree removal:

- the potential for elevated post-fire bark beetle activity in sugar and ponderosa pine
- the current drier than normal conditions leading to increased moisture stress
- the high level of cambium kill observed in some stands, especially white and red fir areas with heavy surface fuel consumption
- the long-term goal of creating resiliency by shifting species composition from shade tolerant white fir to more shade intolerant pine species in drier portions of the fire area
- the need to reduce the number of fire-injured trees along roadsides that have a high probability of mortality
- the need to meet post-fire fuels objectives
- the need to meet post-fire wildlife objectives
- the need to meet reforestation objectives

Since the American Fire burned later in the growing season, Jeffrey and ponderosa pines had mostly finished needle growth by the time their crowns were scorched. Therefore, the crown scorch guideline for yellow pine (pre-bud break) should be used to mark these species at this time. If tree marking continues next spring/summer, the crown kill guideline for yellow pine (post-bud break) should be used as soon as new growth is clearly visible throughout the crown.

The boring dust created by ambrosia beetles that was observed on many of the bole scorched white and red fir should be considered as evidence of significant wood boring beetle activity if the pockets of dust are evenly distributed over at least 1/3 of the bole circumference. The boring dust is highly visible at this time but could be washed/blown off over the winter. Therefore, red and white fir areas should be marked as soon as possible to take full advantage of this useful indicator.

Hazard tree marking guidelines

Region 5 FHP has recently developed new hazard tree guidelines (Angwin et al 2012). These guidelines more clearly define failure and target potential to help land managers make more informed decisions for hazard tree abatement projects. In using these guidelines for roadside hazards, the district will need to decide which trees need to be removed based on the failure

potential rating of any defect(s) found (including fire-injuries) and the "Exposure Duration" (Long, Short or Intermittent With High Frequency), which reflects such factors as road maintenance level, traffic volume, and degree to which people stop and congregate.

Please keep in mind that the FHP hazard tree and fire-injured tree guidelines are addressing different subjects. The fire-injured tree marking guidelines are predicting tree mortality, not failure potential. The hazard tree guidelines predict tree failure potential and not tree mortality. Both can be used along roadsides to abate existing tree hazards due to defect and remove trees that are likely to die from fire injuries and pose a hazard in the near future. Both guidelines have been provided to the American River Ranger District.

Treatment of cut stumps to prevent Heterobasidion root disease

Fresh cut stumps of fire-injured trees can provide entry courts for Heterobasidion root disease (*Heterobasidion occidentale and H. irregulare*). Stumps of trees killed by fire that have been dead less than 18 months should also be considered susceptible. Therefore, it is recommended that a registered borate compound be applied to all freshly cut conifer stumps >14" dbh in order to reduce the chance of new Heterobasidion root disease centers being created through harvest activity. However, the treatment of true fir stumps may not be beneficial if stands already have a high level of *H. occidentale* (formerly fir, or S-type, annosus root disease). Furthermore, treatment of stumps may not be beneficial in high severity harvest areas where no green trees remain.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431.

/s/ Danny Cluck

Daniel R. Cluck
Forest Entomologist
NE CA Shared Services Area

cc: Kelly Pavlica, Silviculturist, American River RD
Tony Rodarte, Timber Management Officer, American River RD
Mark Brown, Forest Vegetation Officer, Tahoe SO
Forest Health Protection, Regional Office

References:

Smith, S.L. and D.R. Cluck. 2011. *Marking guidelines for fire-injured trees in California*. US Forest Service, Forest Health Protection, Region 5, Susanville, CA. Report # RO-11-01. 13 p.

Angwin, P.A., D.R. Cluck, P.J. Zambino, B.W. Oblinger and W.C. Woodruff. 2012. *Hazard Tree Guidelines For Forest Service Facilities and Roads in the Pacific Southwest Region*. US Forest Service, Forest Health Protection, Region 5, Vallejo, CA. Report # RO-12-01. 40 p.